Rahway River
Flood Risk Management
Feasibility Study

US Army Corps of Engineers
New York District
BUILDING STRONG®

Department of Environmental Protection
New Jersey
Non-Federal Sponsor

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Photo By The Cranford Chronicle

Outline

- Flood Risk Management
- Alternative Formulation Process
- Background/History
- Alternatives Description
- Economics Analysis Overview
- Environmental Analysis
- Questions?

Flood Risk Management

- No Flood Risk Management project can eliminate the risk of flooding. Given a long enough period of time, all projects will experience an event that is larger than the event which they were designed.

- Flood Risk Management (FRM) projects can only reduce the frequency and/or severity of flooding and provide additional time to respond.

- Physical features are only a single component of a flood risk management approach. Insurance, zoning and Emergency Action Plan (EAP) are some other important aspects of Flood Risk Management.

- Communication of accurate and timely information about the risk of living in a flood prone area is critical and best implemented at the local level.

- Flood safety is a shared responsibility and a collaborative approach is required to effectively manage the risk of flooding and to save lives. (Corps, FEMA, State, County, Local Gov., Emergency Personnel, Residents)

USACE Alternative Formulation Process for Feasibility Studies

- Identify Flood Risk Management (FRM) Alternatives
- Screen FRM Alternatives for Effectiveness
- Evaluate Alternatives
  - Compare reduced damages of proposed alternatives against Without Project condition at different flood stages.
- Select & Optimize Plan

USACE Alternative Formulation Process For Feasibility Studies

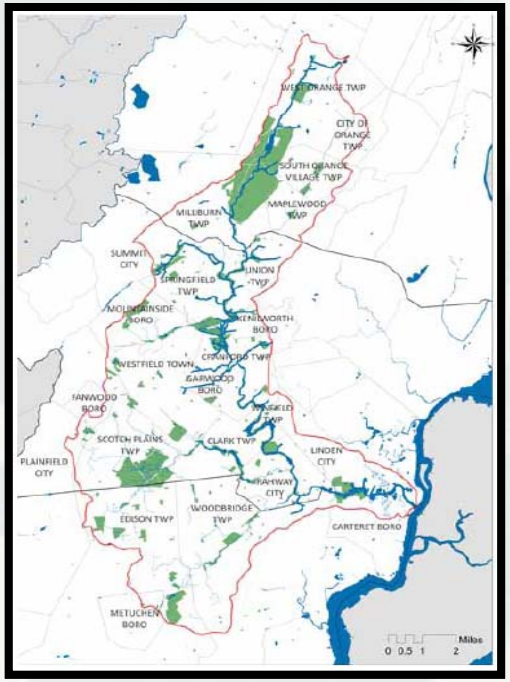
No alternative analysis is complete until the following evaluations are conducted:

1. Hydrology & Hydraulics
   - Modeling existing and improved conditions of the project area flows and water surface elevations
   - Risk and Uncertainty Analysis
2. Environmental Impacts
   - Cultural Resources, HTRW, Biological and Habitat considerations
3. Cost Estimates
   - Based on screening level quantities and estimates
4. Economic Justification for Plan Selection
   - Benefit Cost Ratio >1, maximum net benefits
   - Comparing alternatives at similar levels of protection
5. Social Consequences
   - Community impacts (e.g. displacement, recreational feature/business loss or gains)

USACE Alternative Formulation Process For Feasibility Studies

1. The alternative that maximizes net benefits (benefits-cost) will be the National Economic Development (NED) Plan.
2. Prior to selecting the NED Plan, the Corps of Engineers must complete the following investigations:
    A. Hydrology & Hydraulic Analysis
    B. Cost Estimates
    C. Economic benefits
    D. Environmental impacts
    E. Real Estate considerations
3. Locally Preferred Plan: The feasibility report may present a plan other than the NED plan as the selected plan. However, there are criteria that must be met in order to recommend Locally Preferred Plan (LPP) other than the NED plan. Costs exceeding the NED plan are 100% non-federal sponsor responsibility.
    - LPP must be economically justified and approved at USACE HQ
4. Each alternative will be reviewed by the NJDEP (non-federal sponsor). Coordination with the NJDEP, the local municipalities, and the public will be ongoing.

Rahway River Feasibility Study Background



- The Rahway River Basin has a drainage area of approximately 81.9 square miles and encompasses Essex, Union, and Middlesex counties.
- Flooding within the basin has caused damage to houses, businesses, municipal facilities and public infrastructure.
- The most damaging floods of record within the Rahway River Basin resulted from the storms of July 1938, May 1968, August 1971, August 1973, July 1975, June 1992, October 1996, July 1997, Tropical Storm Floyd in September 1999 , April 2007 Nor'easter, and Hurricane Irene in August 2011.
- 1999: USACE completes Reconnaissance Report recommending a feasibility study to develop flood risk management alternatives within the Rahway River Basin.

Rahway River Feasibility Study History

- 2002: Feasibility Study Cost Share Agreement executed between the USACE and New Jersey Department of Environmental Protection (NJDEP) as the Non-federal sponsor.
  - Feasibility Study Cost Share: 50% Federal; 50% Non-Federal Sponsor
- 2006: Completion of an Initial Screening Report identifying Cranford Township and a portion of the City of Rahway along Robinson's Branch having greatest potential for Federal Interest.
- **Current Status**:
  - Study has predominantly focused on the Cranford area:
    - Completed work includes surveys, existing conditions hydrology and hydraulics, environmental and cultural.
    - Formulation of flood risk management alternatives for Cranford and upstream communities
    - Economic analysis has been contracted out to A/E firm and is underway with contractor/Corps
  - Initiated existing conditions analysis for City of Rahway.

Alternatives

Alternatives Under Consideration

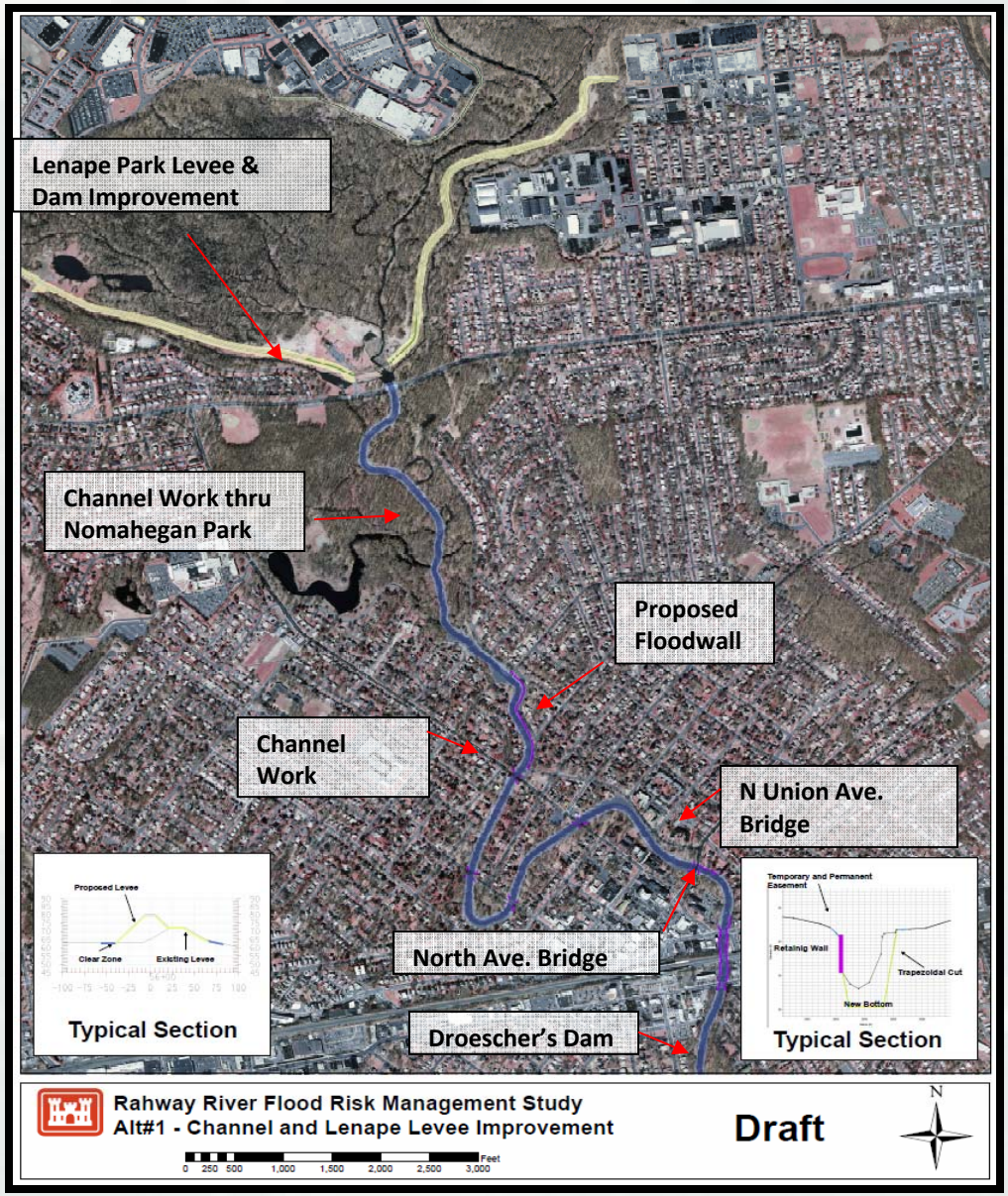
1. Lenape Park Detention Basin and Channel Improvements
2. Lenape Park Detention Basin and Nomahegan Park Levee Modifications and Channel Improvements
3. Channel Improvements and Deepening Orange Reservoir
4. Channel Improvements and Modifying Orange Reservoir Outlet
5. Channel Improvemenst and South Mountain Reservoir regional dry detention basin
6. South Mountain Reservoir regional dry detention basin Standalone
7. Non-Structural

Alternative #1:
Lenape Park Detention Basin & Channel Improvements

- Description:
  - Modification Lenape Park dam/levee system. Approximately 9,500 ft of levee will be raised by 6 ft.
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township
  - Two bridge replacements.
  - Removal of Droescher's and Hansel Dam.
  - Utility relocation.

- This plan has a 1% chance of annual exceedance (100 yr) in Cranford Township and a minimal reduction in water surface elevations (WSEs) for towns downstream of Cranford.

Alternative #1: Lenape Park Detention Basin and Channel Improvements

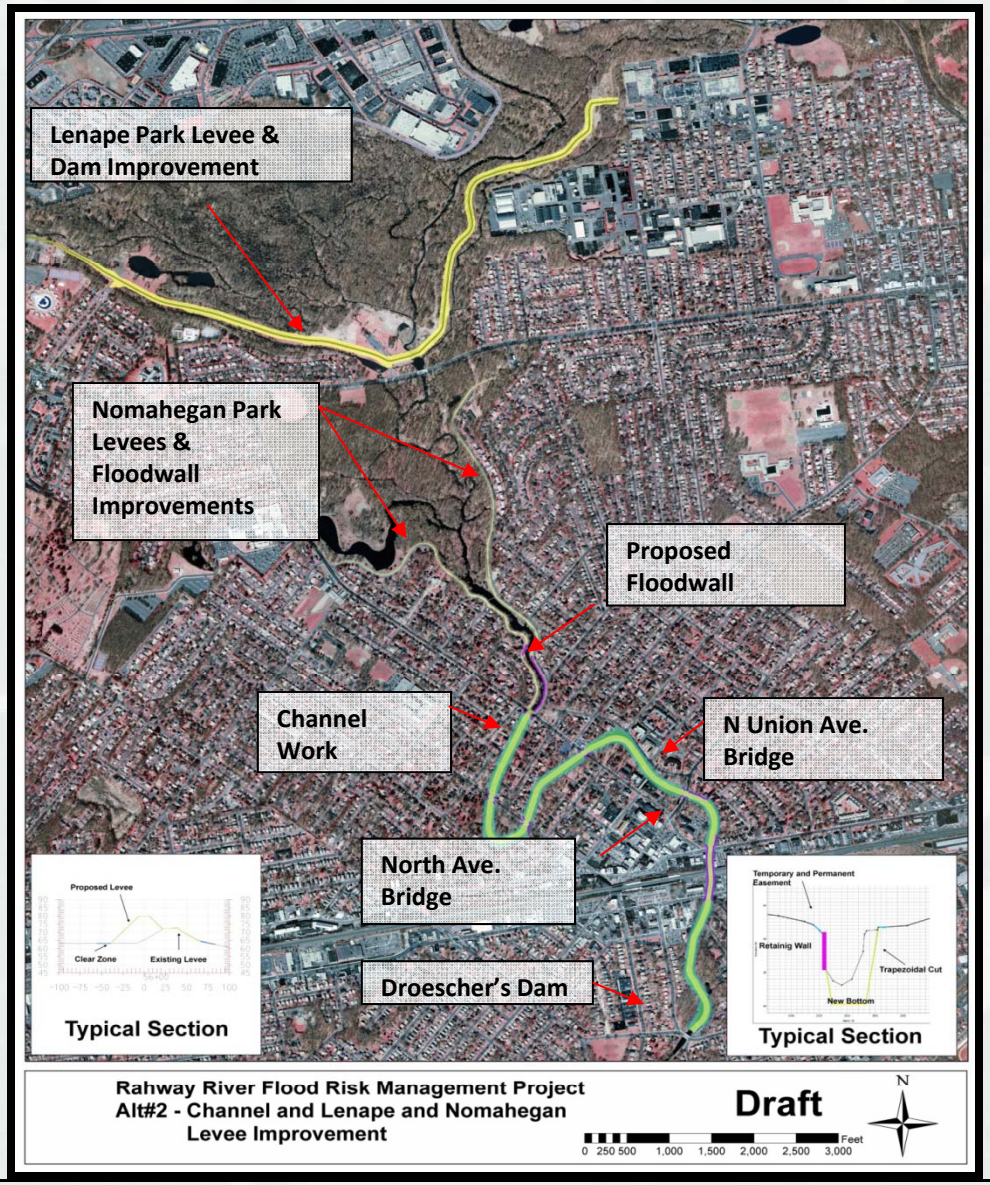


Alternative #2: Lenape Park Detention Basin and Nomahegan Park Levee Modifications and Channel Improvements

- Description:
  - Modification Lenape Park dam/levee system. Approximately 9,500 ft of levee will be raised by 6 ft.
  - Modification to Nomahegan levees, raising approximately 9,300ft of levee and adding approximately 900 ft of floodwalls.
  - Approximately 9,700 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township.
  - Two bridge replacements.
  - Removal of Droescher's and Hansel Dam.
  - Utility relocation.

- This alternative is likely to contain the 1% chance of annual exceedance flood (100yr event) in Cranford Township.

Alternative #2: Lenape Park Detention Basin and Nomahegan Park Levee Modifications and Channel Improvements

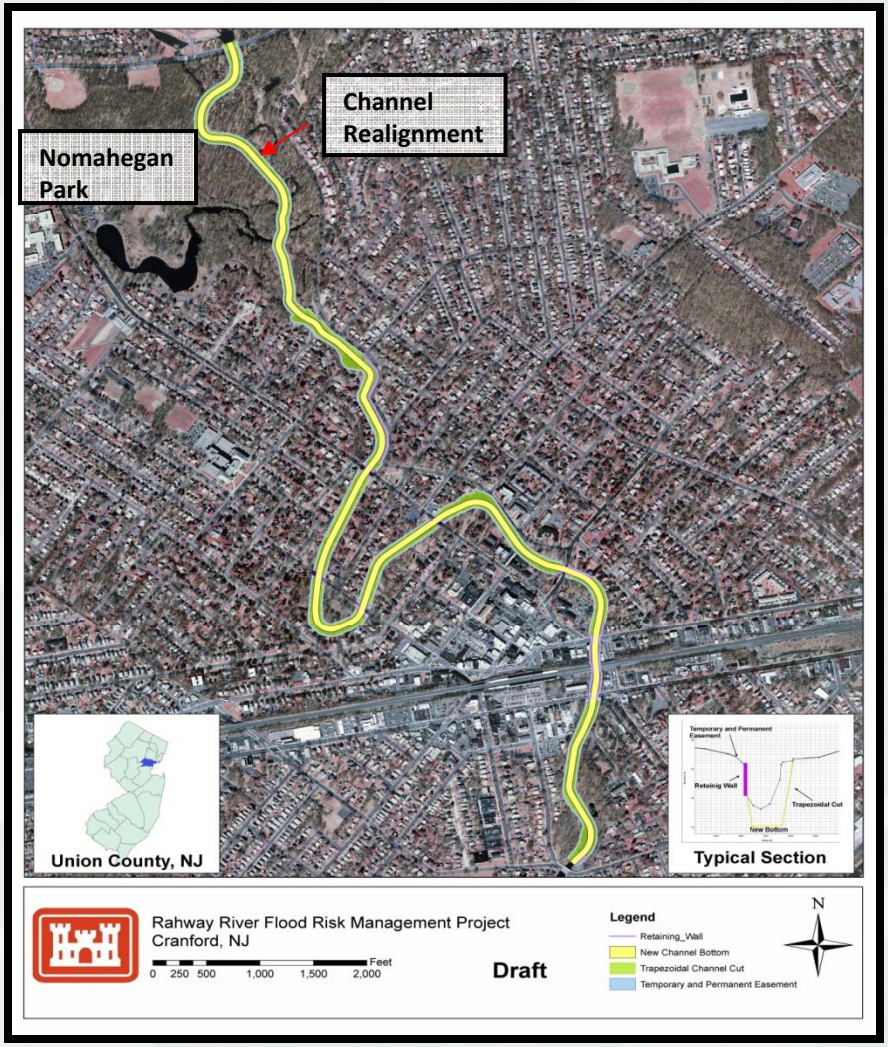


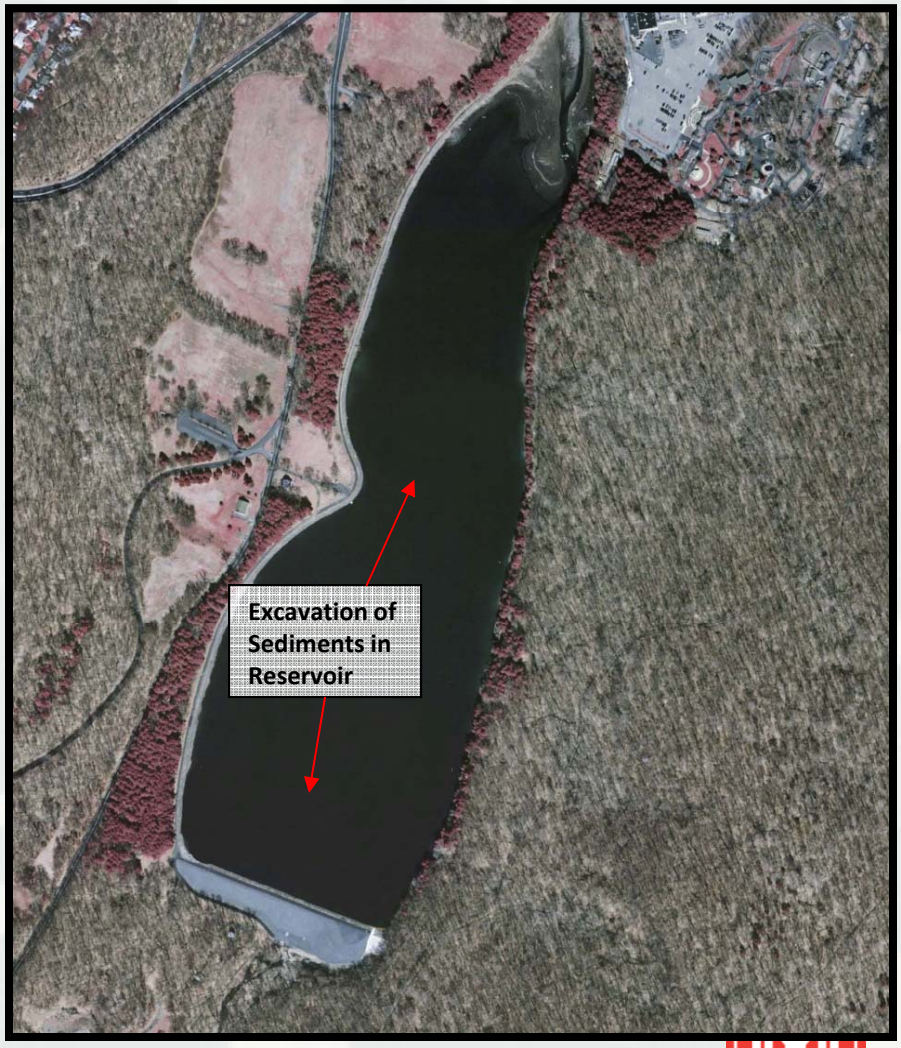
Alternative #3: Channel Improvements and Deepening Orange Reservoir

- Description:
  - Dredging Orange Reservoir to increase storage capacity.
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township.
  - Two bridge replacements.
  - Removal of Droescher's and Hansel Dam.
  - Utility relocation.

- This alternative is likely to contain the 1%-2% chance of annual exceedance flood in Cranford Township.

Alternative #3: Channel Improvements and Deepening Orange Reservoir





Alternative #4: Channel Improvements and Modifying Orange Reservoir Outlet

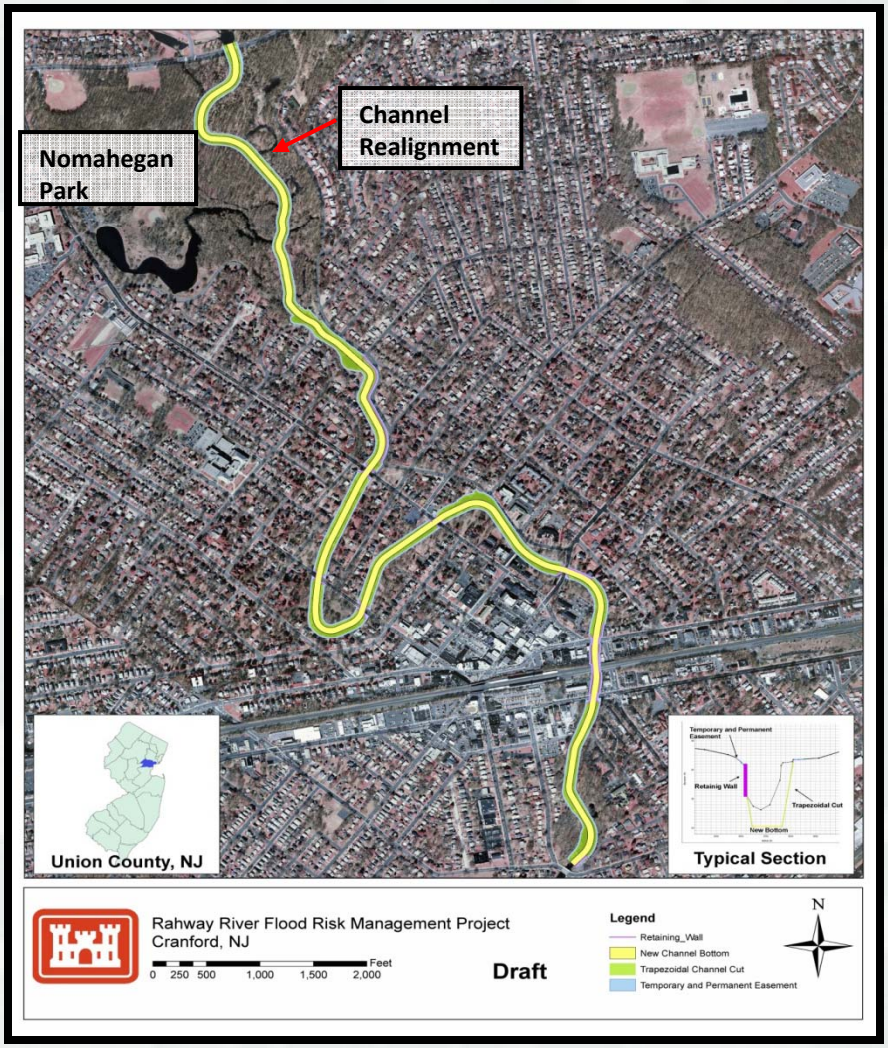
- Description:
  - New outlet 2- 30” pipes at Orange Reservoir, with manual operation.
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township.
  - Two bridge replacements.
  - Removal of Droescher’s and Hansel Dam.
  - Utility relocation.

*Events	Time
Drawdown	2 days
Re-fill - (25 yr event)	30 hrs
Re-fill - (1 yr event)	One week
Maximum re-fill	Two weeks

*Drawdown and refill depth = 15ft.

- This alternative is likely to contain the 1%-2% chance of annual exceedance flood in Cranford Township. The flow detention capacity of the Orange Reservoir will mitigate the increase in flow conveyance capacity obtained by deepening and widening the channel.

Alternative #4: Channel Improvement and Modifying Orange Reservoir Outlet



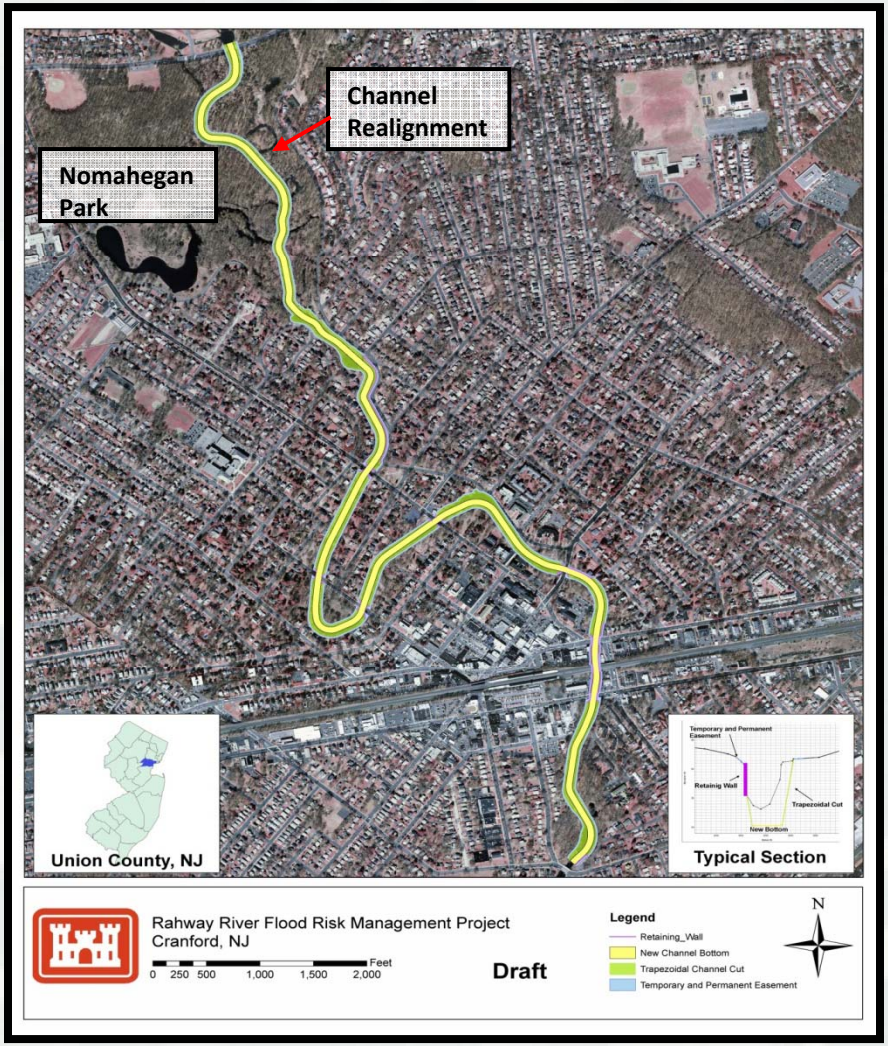
Alternative #5: Channel Improvement with South Mountain Reservoir (dry detention basin)

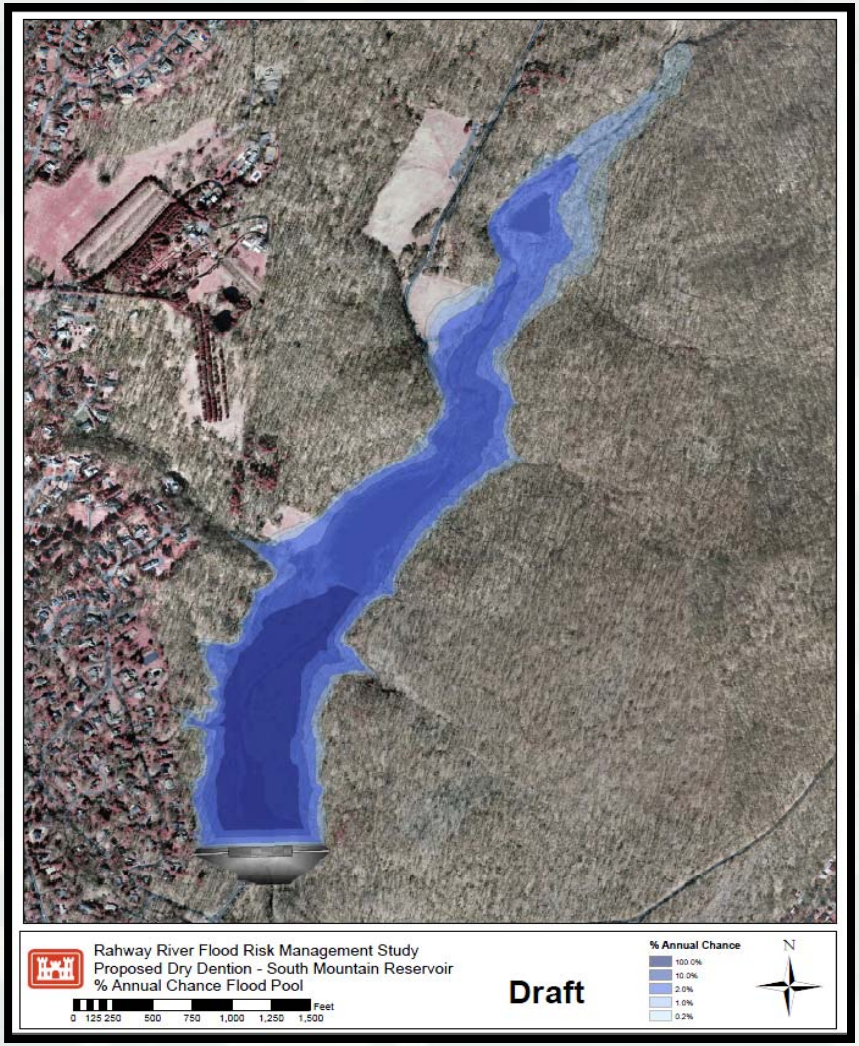
- Description:
  - New regional dry detention basin in South Mountain Reservation crossing the West Branch of the Rahway River and Brookside Drive. The dry detention structure will be approximately 880 ft long by 70 ft high earthen dam.
  - Approximately 15,500 ft of trapezoidal channel improvements throughout the Rahway River in Cranford Township.
  - Two bridge replacements.
  - Removal of Droescher's and Hansel Dam.
  - Utility relocation.

Drawdown	Time (days)	Area (acre)
100 yr event	3.50	80
50 yr event	3.00	68
1 yr event	1.25	23

- This alternative is likely to contain the 1% chance of annual exceedance flood in Cranford Township. Additional benefits to municipalities upstream.

Alternative #5: Channel Improvement with South Mountain Reservoir



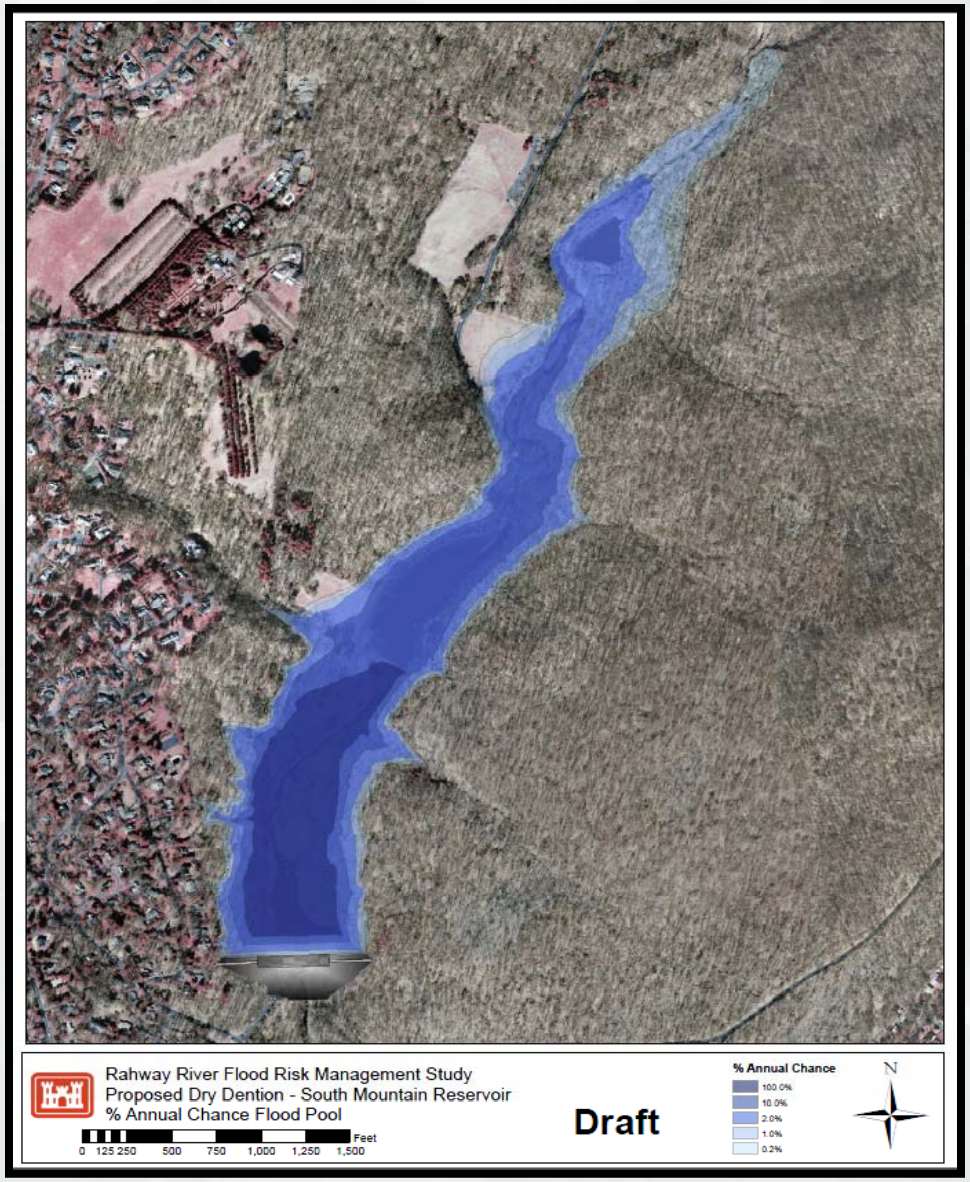


Alternative #6: South Mountain Reservoir Standalone

- Description:
  - New regional dry detention basin in South Mountain Reservation crossing the West Branch of the Rahway River and Brookside Drive. The dry detention structure will be approximately 880 ft long by 70 ft high earthen dam.

- This alternative is likely to contain the 2% chance of annual exceedance flood (50yr-event) in Cranford Township. Additional benefits to municipalities upstream.

Alternative #6: South Mountain Reservoir Standalone



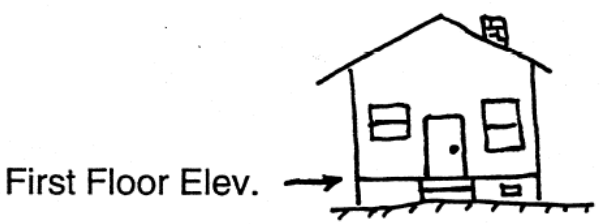
Alternative #7: Non-structural

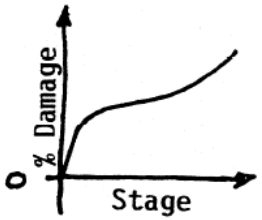
- Description: Non-structural analysis of the 1% and 10% exceedance (100- and 10-yr event) only in Cranford Township.
- There are eight different actions that are considered for a structure at this stage. These include:
  - raising the structure,
  - constructing a ringwall around the structure,
  - wet or dry flood proofing,
  - relocating utilities, and
  - buyouts if all other non-structural actions are more expensive.

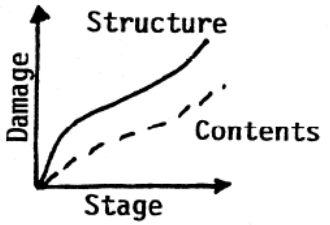
Economic Analysis Overview

Economic Analysis Overview

- Identify and generate floodplain
- Inventory structures and gather key data
- Valuation of Structures







- Structure ID
- Location/Address
- Structure Value
- Content Ratio
- Damage Category

- Depth-Damage Function
- First Floor Stage
- Ground Stage
- Coordinates
- Stream Station

Economic Analysis Overview

- Inundation Damages
  - Structure and Content
  - Infrastructure
  - Automobile
- Other Damages
  - Public Emergency Cost
  - Traffic Delay Cost
  - Lost Income

Economic Analysis Overview

Establish Stage-Frequency Relationships

- Riverine Studies:
  - Sample of stage frequency table
    - Frequency – probability of storm event
    - Stage – flood elevation in ft

Frequency	Stage
0.5	6.9
0.2	8.7
0.1	10.1
0.04	11.9
0.02	13.3
0.01	14.7
0.005	16.1
0.002	18.0

Economic Analysis Overview

Sample Computation of Expected Annual Damage (EAD)

EXPECTED ANNUAL STORM DAMAGE COMPUTATIONS

FREQUENCY	PROBABILITY	DIFFERENCE IN PROBABILITIES	DAMAGES	AVERAGE OF DAMAGES	EXPECTED ANNUAL DAMAGE	
					INTERVAL	SUMMATION
~	0.0%		$3,591,129		$7,182	**$150,551**
		0.2%		$3,591,129		
500	0.2%		$3,591,129		$9,513	$143,369
		0.3%		$3,170,873		
200	0.5%		$2,750,617		$12,391	$133,856
		0.5%		$2,478,262		
100	1.0%		$2,205,907		$18,343	$121,465
		1.0%		$1,834,255		
50	2.0%		$1,462,602		$23,458	$103,123
		2.0%		$1,172,891		
25	4.0%		$883,180		$36,816	$79,665
		6.0%		$613,603		
10	10.0%		$344,026		$22,700	$42,849
		10.0%		$227,002		
5	20.0%		$109,978		$17,866	$20,148
		30.0%		$59,554		
2	50.0%		$9,129		$2,282	$2,282
		50.0%		$4,565		
1	100.0%		$0			

Economic Analysis Overview

Project Plans

Without - Project Conditions

- **Baseline condition -** from which all flood risk management plans are measured.
- Represents the condition of the study area in terms of hydrology, hydraulics, and flood damage over the period of analysis (e.g. 50-years) if flood risk management measures are not implemented.

Project Plans

With - Project Conditions

- Represent the condition of the study area in terms of hydrology, hydraulics, and flood damage over the period of analysis with a specific flood risk management plan in place.
- Economic impacts are determined by comparing “With-Project Conditions” vs. the “Without-Project Condition.”

Economic Analysis Overview

Sample Computation of Net Annual Benefit

EAD and the NED Plan

Plan Name	Expected Annual Damage			Annual Project Cost	Net Annual Benefits
	Total W/O Project	Total With Project	Damages Reduced (Benefits)		
Without Project Conditions	780.48	780.48	0.00	0.00	0.00
Plan 1 (Detention & Chan Improvement)	780.48	582.67	197.82	189.19	8.63
Plan 2 (Floodwall)	780.48	446.02	334.46	311.12	23.34
Plan 3 (Detention, Chan Imp, Floodwall)	780.48	360.65	419.83	448.16	-28.33

Net Annual Benefit = EAD Reduced – Annualized Project Cost

NED Plan provides the greatest Net Annual Benefit

Economic Analysis Overview

- Benefit/Cost Analysis is not a comparison between First Costs (initial construction cost of project) and Benefits (damages reduced)
- Benefit/Cost Analysis is not a comparison between individual storm events and benefits
- Benefit/Cost Analysis is a comparison of annualized benefits and costs that takes into account different storm frequencies over a 50 year period of analysis

Questions?

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